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Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Macroalga *Laminaria digitata* as potential carbon source in heterotrophic *Chlorella protothekoides* cultivation: an innovative biorefinery concept

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Algae are considered as one of the most promising and suitable feedstock to produce energy and high value products in a sustainable way (Wei et al. 2013). Algae can generate more biomass than terrestrial crops do and, growing in water, they can overcome the land competition problem.
Moreover, microalgae, unicellular organisms able to grow by autotrophic and heterotrophic conditions, are receiving increasing interest due to their composition. The variety of products that can be obtained by microalgae is extremely huge ranging from basic chemical substances such as vitamins to high value products as pigments (Borowitzka 2013).
The focus of this research was on two brown macroalgae species: *Laminaria digitata* and *Saccharina latissima*. Both macroalgae are the most common species in Danish waters with solid cultivation techniques (Andersen 2005). Thanks to their composition rich in sugars they represent an interesting nutrient source in heterotrophic microalgae cultivation.
Therefore an integrated biorefinery concept has been developed for conversion of *L. digitata* and *S. latissima* into energy carriers and a protein enriched fish feed. Sugars and nutrients from macroalgae can be recovered by enzymatic hydrolyses and used as substrate for the growth of heterotrophic *Chlorella protothekoides* units to be used directly as fish feed (Figure 1).

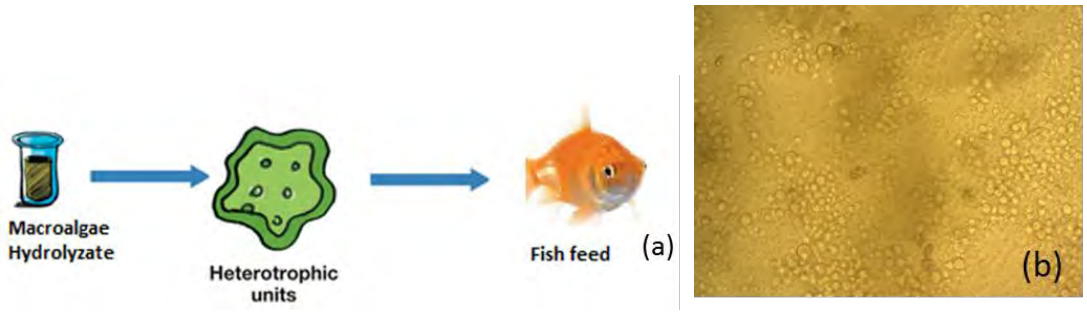

Figure 1: Scheme of the process (a) and *C.protothekoides* cells grown in macroalgae hydrolyzed (b)

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